Nā Kilo Hōkū

THE ONES WHO LOOK TO THE STARS

A Newsletter from the Institute for Astronomy, University of Hawai'i

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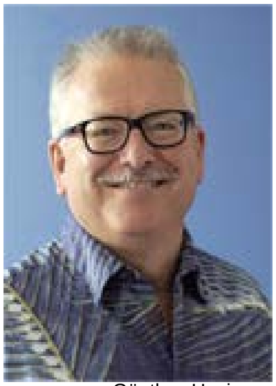


Günther Hasinger

All Articles

From the Director

It is significant that for two years in a row, recent PhD recipients from IfA, H. Jabran Zahid and Brendan Bowler, have received the Robert J. Trumpler Award given by the Astronomical Society of the Pacific "to a recent recipient of the PhD degree in North America whose research is considered unusually important to astronomy." In 2012 one of two Trumpler recipients was IfA alumna Emily Levesque.

Our students also win their share of awards given by the University of Hawaiʻi and local organizations. In recent years, Andrew Mann, Bowler, Chris Beaumont, Zahid, BJ Fulton, and Chao-Ling Hung have all won UH excellence in research awards at the master's or PhD levels. Scott Dahm (2004), Levesque (2009), and Beaumont (2012) won the Achievement Rewards for College Scientists (ARCS) Scholar of the Year award.

Once our students graduate, they often receive prestigious fellowships to support their postdoctoral work. For example, Jeyhan Kartaltepe (PhD 2009), Levesque (PhD 2010), Steven Rodney (PhD 2010), and Sean Andrews (PhD 2007) all won Hubble Fellowships supported by NASA. These fellowships are open not only to US citizens, but any other English-speaking astronomers. Fellows receive a very competitive salary and a sizable research allowance that can be used at a US institution of the fellow's choice for up to three years. The competition for these awards is tough.

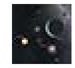
In the long run, our alumni do well in astronomy, with 83 percent staying in the field. About 50 percent have jobs in astronomy research, while a third are astronomy faculty at institutions of higher learning.

We are very proud of our graduate students and alumni.

Stargazing and Public Lectures

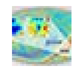
Join us for free public events related to the General Assembly of the International Astronomical Union. Details [here](#).

Highlights



[Robotically Discovering Earth's Nearest Neighbors](#)

[PLANETS Telescope to Explore Solar System Atmospheres, Exoplanets](#)



[A Cold Cosmic Mystery Solved](#)

Upcoming Events

"[The Relativity Tour](#)" celebrating the 100th Anniversary of Einstein's General Theory of Relativity with Dr. Jeffrey Bennett, **August 10**, 7:30 p.m., University of Hawaiʻi at Mānoa [Art Building Auditorium (room 132)](#).

[More Events>>](#)

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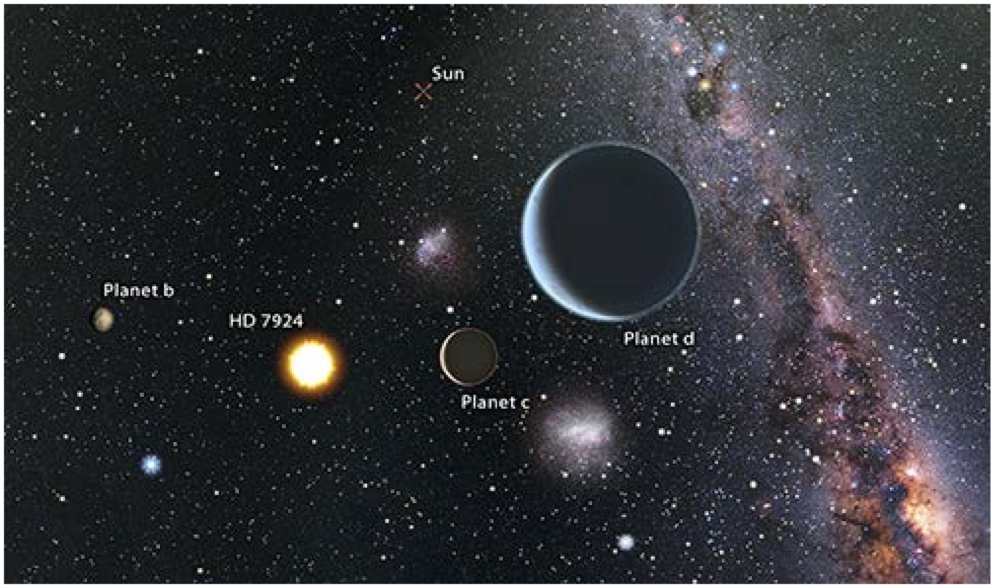
Robotically Discovering Earth's Nearest Neighbors



Artists' impression of a view from the HD 7924 planetary system looking back toward our Sun, which would be easily visible to the naked eye. Since HD 7924 is in our northern sky, an observer looking back at the Sun would see objects like the Southern Cross and the Magellanic Clouds close to our Sun in their sky. Art by Karen Teramura & BJ Fulton, UH IfA.

A team of astronomers, including IfA astronomer Andrew Howard and IfA graduate students Evan Sinukoff and BJ Fulton, discovered a planetary system orbiting a star that is only 54 light-years away. They found the planets using measurements from the Automated Planet Finder (APF) Telescope at the University of California's Lick Observatory, the W. M. Keck Observatory on Maunakea, and the Automatic Photometric Telescope (APT) at Tennessee State University's Fairborn Observatory in Arizona. All three planets orbit their star at a distance closer than Mercury orbits the Sun, completing their orbits in just 5, 15, and 24 days.

The team discovered the new planets by detecting the wobble of the star HD 7924 as the planets orbited and pulled on the star gravitationally. APF and Keck Observatory traced out the planets' orbits over many years using the Doppler technique that has successfully found hundreds of mostly larger planets orbiting nearby stars. APT made crucial measurements of the brightness of HD 7924 to assure the validity of the discoveries.

The Keck Observatory found the first evidence of planets orbiting HD 7924, discovering the innermost planet in 2009. It took five years of additional observations at Keck and the year-and-a-half campaign by the APF Telescope to find the two additional planets. The new APF facility offers a way to speed up the planet search because APF is a dedicated facility that robotically searches for planets every clear night. Training computers to run the observatory all night, without human oversight, took years of effort by the University of California Observatories staff and graduate students on the discovery team. "We initially used APF like a regular telescope, staying up all night searching star to star. But the idea of letting a computer take the graveyard shift was more appealing after months of little sleep. So we wrote software to replace ourselves with a robot," said Fulton. "This level of automation is a game-changer in astronomy," said Howard. "It's a bit like owning a driverless car that goes planet shopping."

The Kepler Space Telescope has discovered thousands of extrasolar planets and demonstrated that they are common in our Milky Way galaxy. However, nearly all of these planets are far from our solar system. Most nearby stars have not been thoroughly searched for the small “super-Earth” planets (larger than Earth but smaller than Neptune) that Kepler found in great abundance. This discovery shows the type of planetary system that astronomers expect to find around many nearby stars in the coming years. “The three planets are unlike anything in our solar system, with masses 7–8 times the mass of Earth and orbits that take them very close to their host star,” explained University of California, Berkeley graduate student Lauren Weiss, another member of the team.

Observations by APF, APT, and Keck Observatory helped verify the planets and rule out other explanations. “Starspots, like sunspots on the Sun, can momentarily mimic the signatures of small planets. Repeated observations over many years allowed us to separate the starspot signals from the signatures of these new planets,” Sinukoff explained.

The robotic observations of HD 7924 are the start of a systematic survey for super-Earth planets orbiting nearby stars. Fulton will lead this two-year search with the APF as part of the research for his doctoral dissertation. “When the survey is complete we will have a census of small planets orbiting Sun-like stars within approximately 100 light-years of Earth,” says Fulton.

In honor of the donations of Gloria and Ken Levy that helped facilitate the construction of the Levy spectrograph on APF and supported Weiss, the team has informally named the HD 7924 system the “Levy Planetary System.”

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PLANETS Telescope to Explore Solar System Atmospheres, Exoplanets

Model of the PLANETS telescope structure

A big telescope is not necessarily the best possible instrument for all purposes. "Sometimes we don't need a bigger telescope, we just need a better telescope," explains Jeff Kuhn, the IfA scientist spearheading the development of the 2-meter PLANETS (Polarized Light from Atmospheres of Nearby ExtraTerrestrial Systems) telescope on Haleakalā.

One of the primary goals of this telescope will be detecting the light from exoplanets and from the outer atmospheres of planets in our solar system. Achieving this goal requires minimizing scattered light from the host star (or planet) and maximizing the ability of the telescope's detectors to see faint objects near a very bright one. To achieve this goal, PLANETS will be different from most telescopes in that it is designed for what scientists call "high photometric dynamic range." Until the Daniel K. Inouye Solar Telescope comes online a few years later, PLANETS will be the world's largest off-axis optical telescope, which means there will be no obstructions to the incoming beam of light due to the secondary mirror and its supports. To minimize its cost, the telescope will also use innovative technology to achieve the thinnest primary mirror of any comparable astronomical telescope. All of its design features greatly reduce the amount of diffraction—the unwanted “glare” from light that is spread out as a result of passing through a narrow aperture or across an edge. PLANETS’ mirror will also be polished to be very smooth to minimize diffuse scattered light from mirror roughness, a major source of light scattering.

PLANETS will also have a stellar coronagraph to block out the blinding glare from the star. While most coronagraphs have been used to create an artificial solar eclipse to see the corona of our Sun, the PLANETS’ stellar coronagraph can be used to see planets around other stars, the disks that form them, or the tenuous outer atmospheres of solar system planets like Mercury. These exoplanets, outer atmospheres, and disks can be millions to billions times fainter than the glare around them. Making a telescope capable of containing and removing the glare allows for the detection and study of the light from the faint source. In this way, PLANETS can also be used to see a variety of what would otherwise be hidden objects.

The State of Hawai‘i DLNR permit process that would allow PLANETS to be installed at Haleakalā Observatories in a “re-tasked” structure that houses the University of Chicago Neutron Monitor observatory has been initiated. The major scientific and funding partners for this project include Tohoku University in Sendai, Japan, the Kiepenheuer Institute for Solar Physics in Freiberg, Germany, and the IfA. If the project receives final DLNR approval, it will take about two years to complete.

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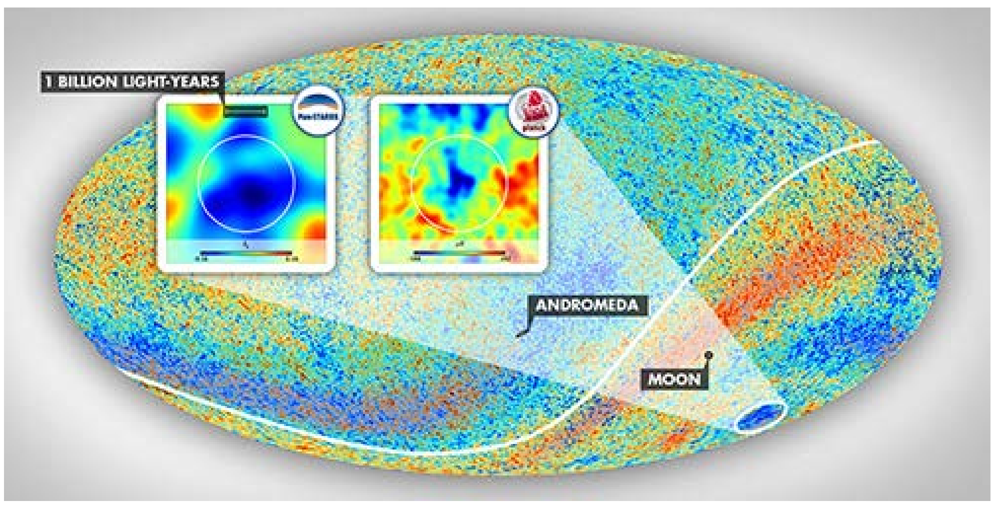
A Cold Cosmic Mystery Solved

In 2004, astronomers examining a map of the radiation leftover from the Big Bang (the cosmic microwave background, or CMB) discovered the Cold Spot, a larger-than-expected unusually cold area of the sky. The physics surrounding the Big Bang theory predicts warmer and cooler spots of various sizes in the infant Universe, but a spot this large and this cold was unexpected.

Now, a team of astronomers led by IfA astronomer István Szapudi may have found an explanation for the existence of the Cold Spot, which Szapudi says may be "the largest individual structure ever identified by humanity." If the Cold Spot originated from the Big Bang itself, it could be a rare sign of exotic physics that the standard cosmology (basically, the Big Bang theory and related physics) does not explain. If, however, it is caused by a foreground structure between us and the CMB, it would be a sign that there is an extremely rare large-scale structure in the mass distribution of the Universe.



The Cold Spot area resides in the constellation Eridanus in the southern galactic hemisphere. The insets show the environment of this anomalous patch of the sky as mapped by Szapudi's team using PS1 and WISE data and as observed in the cosmic microwave background temperature data taken by the Planck satellite. The angular diameter of the vast supervoid aligned with the Cold Spot, which exceeds 30 degrees, is marked by the white circles. Graphics by Gergő Kránicz. Image credit: ESA Planck Collaboration.

Using data from the Pan-STARRS1 (PS1) telescope located on Haleakalā, Maui, and NASA's Wide Field Survey Explorer (WISE) satellite, Szapudi's team discovered a large supervoid, a vast region 1.8 billion light-years across, in which the density of galaxies is much lower than usual in the known Universe. This void was found by combining observations taken by PS1 at optical wavelengths with observations taken by WISE at infrared wavelengths to estimate the distance to and position of each galaxy in that part of the sky.

Earlier studies, also done in Hawai'i, observed a much smaller area in the direction of the Cold Spot, but they could establish only that no very distant structure is in that part of the sky. Paradoxically, identifying nearby large structures is harder than finding distant ones, since we must map larger portions of the sky to see the closer structures. The large three-dimensional sky maps created from PS1 and WISE by Dr. András Kovács (Eötvös Loránd University, Budapest, Hungary) were thus essential for this study. The supervoid is only about 3 billion light-years away from us, a relatively short distance in the cosmic scheme of things.

Imagine there is a huge void with very little matter between you (the observer) and the CMB. Now think of the void as a hill. As the light enters the void, it must climb this hill. If the Universe were not undergoing accelerating expansion, then the void would not evolve significantly, and light would descend the hill and regain the energy it lost as it exits the void. But with the accelerating expansion, the hill is measurably stretched as the light is traveling over it. By the time the light descends the hill, the hill has gotten flatter than when the light entered, so the light cannot pick up all the energy it lost upon entering the void. The light exits the void with less energy, and therefore at a longer wavelength, which corresponds to a colder temperature.

Getting through a supervoid can take millions of years, even at the speed of light, so this measurable effect, known as the Integrated Sachs-Wolfe effect, might provide the first explanation for one of the most significant anomalies found to date in the CMB, first by a NASA satellite called the Wilkinson Microwave Anisotropy Probe (WMAP), and more recently, by Planck, a satellite launched by the European Space Agency.

While the existence of the supervoid and its expected effect on the CMB do not fully explain the Cold Spot, it is very unlikely that the supervoid and the Cold Spot at the same location are a coincidence. The team will continue its work using improved data from PS1 and from the Dark Energy Survey being conducted with a telescope in Chile to study the Cold Spot and supervoid, as well as another large void located near the constellation Draco.

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IfA-Led Team Successfully Observes Solar Eclipse over the Arctic

Photo by Miloslav Druckmüller

The international Solar Wind Sherpas team, led by IfA astronomer Shadia Habbal, braved Arctic weather to successfully observe the total solar eclipse of March 20 from Longyearbyen on the island of Spitsbergen in the Svalbard archipelago east of northern Greenland. IfA astronomer Haosheng Lin and IfA Research Associate Garry Nitta also participated in the expedition.

It was no easy feat. Ever-changing weather predictions, subzero temperatures of –4 degrees F (–20 C) and the danger from polar bears were some of the challenges the team faced, but their years of preparation paid off. The sky over the snow-covered landscape was crystal clear before, during, and after totality, so they were able to capture a beautiful solar corona.

Because the Svalbard archipelago, like the Hawaiian Islands, has microclimates, the team observed at two locations to increase its chances of seeing the eclipse. With local support, the team was able to set up its equipment inside the old Northern Light Observatory and observe the event through specially designed doors that replaced the old windows, and to use an airport hangar located 10 miles away.

Identical sets of imaging instruments were set up at both locations, with six digital SLR cameras fitted with different focal length lenses, and four astrophotography cameras with special filters to observe the colors of light given off by ionized iron atoms, stripped of 10 and 13 electrons. These highly ionized atoms probe the high temperature outer layers, or corona, of the Sun. In addition, a special instrument, called a dual-channel imaging spectrograph was used at the observatory to measure the motions of these ions in the Sun's corona. At the airport, Lin used a spectropolarimeter that he designed and constructed to measure the Sun's magnetic fields.

The shadow bands, thin bands of light and dark observed prior to and during totality, were remarkable as the snow-covered landscape offered ideal conditions for seeing them. The corona of the eclipsed

Sun, which was at an altitude of 12 degrees, was shimmering throughout the 2 minutes and 20 seconds of totality, with one large prominence clearly visible to the naked eye.

To further maximize the likelihood of observing the corona during this eclipse, other members of the Solar Wind Sherpas team observed from three other sites: the Faroe Islands, located between Iceland and Norway; a Falcon Dassault flying at 49,000 feet (15,000 m) over the Faroe Islands, and an Irish Air Corps CASA CN235 flying out of Dublin. All were successful except for the group on the Faroe Islands, where rain prevented them from observing totality.

Preliminary results were presented at the Triennial Earth-Sun Summit (TESS) meeting in April. Their results will be published once the analysis is completed.

The 2015 Solar Wind Sherpas also included Prof. Adalbert Ding (Technische Universität and Institute for Technical Physics, Berlin), who designed and constructed the dual-channel imaging spectrograph, as well as participants from Colorado, Massachusetts, Texas, the Czech Republic, Germany, Saudi Arabia, and Wales. In addition, Peter Gallagher of Trinity College, Dublin, was instrumental in securing the CASA CN235 flight. He and Joe McCauley were involved in setting up the equipment and acquiring the observations from that platform.

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Zahid Wins Prestigious Trumpler Award

H. Jabran Zahid
Photo by M. Taddonio

For the second year in a row, a recent IfA alumnus has received the Robert J. Trumpler Award, given by the Astronomical Society of the Pacific to recognize a recent PhD thesis considered unusually important to astronomy. The 2015 recipient is Dr. H. Jabran Zahid, who received his PhD in 2014.

Zahid's thesis work measured the chemical evolution of galaxies using existing and new data from large extragalactic surveys, and compared these results with the predictions of cosmological simulations. Highly motivated to understand his observational results from a theoretical perspective, he extended this work by developing the theoretical links between galactic chemical evolution, dust, and star formation in galaxies.

IfA Director Guenther Hasinger stated, "Jabran embarked on his PhD thesis with extraordinary drive, innate ability, and independence. His thesis work yielded nine first-author refereed journal articles that comprehensively span observations and theory, and has already been cited by other researchers over 250 times."

Zahid is now a Clay Postdoctoral Fellow at the Harvard-Smithsonian Center for Astrophysics. The 2014 recipient was Dr. Brendan P. Bowler, who is now a postdoctoral fellow at the California Institute of Technology, Joint Center for Planetary Astronomy.

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IfAers Win Excellence in Research, ARCS Awards

Karen Meech
Photo courtesy UH

IfA astronomer **Karen Meech** has won a 2015 Regents' Medal for Excellence in Research. It is awarded by the UH Board of Regents "in recognition of scholarly contributions that expand the boundaries of knowledge and enrich the lives of students and the community." Meech has been a pioneer in observing the behavior of comets. Her research bridges the boundaries between astronomy, planetary science, geology and astrobiology. Her work investigating the leftovers of the planetary building process has contributed to the understanding of the conditions during the time our solar system was put together.

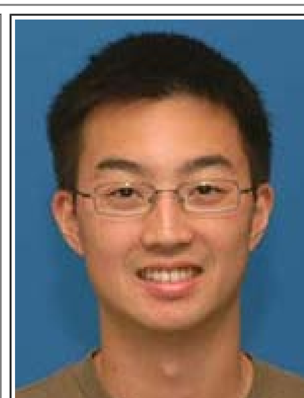
She has been a co-investigator on three NASA comet missions for which she led the ground-based observing campaigns. She has also led a large interdisciplinary research program in astrobiology at UH investigating water and habitability. In particular, she has led the development of space mission concepts focused on the big-picture questions surrounding the origin of Earth's water.

Her research has been recognized with other awards, including the 1994 Harold C. Urey Prize, given by the Division of Planetary Sciences of the American Astronomical Society to recognize outstanding achievements in planetary science by an early-career scientist. The American Association of Variable Star Observers recognized her service to teaching and outreach through the William Tylor Olcott Award.

Two IfA graduate students, **BJ Fulton** and **Chao-Ling Hung**, received awards from UH Mānoa for excellence in research. Fulton, a current National Science Foundation Graduate Student Research Fellow, received the master's level award. His research focuses on the discovery, characterization, and demographics of planets around nearby stars (exoplanets) using robotic telescopes. His primary contributions thus far have been to develop the framework that allows for a completely automated search for planets, which has already yielded three new planet discoveries (see "Robotically Discovering Earth's Nearest Neighbors" in this issue). He also plans to use the statistical properties of the planets discovered to determine how common Earth-like planets are in our local solar neighborhood. Fulton has published four first-author papers and is a contributing author on more than two dozen other studies, including two published in the journal *Nature*. He is now pursing a PhD at UH and hopes to be the first to discover a nearby example of an exoplanet with the prospect of harboring life.

BJ Fulton

Chao-Ling Hung



Nicholas Lee

Hung received the doctoral level award. Her research has focused on understanding the formation and evolution of the most luminous galaxies in the Universe. Hung has been studying what physical mechanisms are responsible for triggering these extreme galaxies in the early Universe by characterizing their morphological and dynamical properties. Her dissertation work has resulted in three first-author papers published in the *Astrophysical Journal*, with at least one other paper in preparation. She recently successfully defended her dissertation and will continue her career as the Harlan J. Smith Postdoctoral Fellow at the University of Texas, Austin.

Graduate student **Nicholas Lee** received the Columbia Communications Award in Astronomy from the Achievement Rewards for College Scientists (ARCS) Foundation. For his dissertation, “Tracing Infrared Galaxies Throughout Cosmic Time,” Lee used far-infrared observations from the Herschel Space Observatory to study star formation in distant galaxies and found that massive galaxies are less efficient at star formation than less massive ones. He will study the mechanism that extinguishes star formation as a postdoctoral fellow at the University of Copenhagen.

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Caltech Submillimeter Observatory on Maunakea to End Operations

Photo courtesy CSO.

After almost 29 years, the California Institute of Technology (Caltech) will end operations of the Caltech Submillimeter Observatory (CSO) in Hawaiʻi in September. Caltech will begin the planning for the dismantling of the observatory in close coordination with the Office of Maunakea Management to ensure that it is undertaken promptly and in a culturally and environmentally respectful manner. The site will be restored to its natural state by 2018 according to the Decommissioning Plan approved by the Board of Land and Natural Resources.

Built and operated by Caltech with funding from the National Science Foundation, the 10.4-meter radio telescope began operation near the summit of Maunakea in early 1987. For nearly three decades, astronomers from around the world have used the observatory to pursue research and to accomplish groundbreaking achievements in submillimeter and millimeter astronomy—the study of light emitted by atoms, molecules, and dust grains in the interstellar space where stars and planets form. Well over 100 students, from Caltech and other institutions, have used the CSO for their PhD research.

"The CSO has played a central role in the development of the science and instrumentation of submillimeter and millimeter astronomy over the last three decades," said Sunil Golwala, current CSO director. "The CSO legacy of combining training in instrumentation development, hands-on observing, and science will live on via its former students and researchers as well as in new projects for which it has laid the foundation."

"This has been a most exciting time in which the field of submillimeter astronomy has been developed, leading to an understanding of astrochemistry, star formation, and distant, dust-obscured galaxies," says Tom Phillips, CSO's founding director, who is now director emeritus.

CSO's scientific achievements include determining the volatile composition of comets, including the first ground-based detection of HDO (heavy water) in a comet, leading to an improved understanding of the origin of comets and of terrestrial water.

Hōkū Keʻa, the UH Hilo Educational Telescope on Maunakea, will also be decommissioned. The decommissioning process will begin in early 2016 and is expected to be completed in 2018, after the CSO's decommissioning. Once the areas are restored to their natural state, no new observatory will be built on either site.

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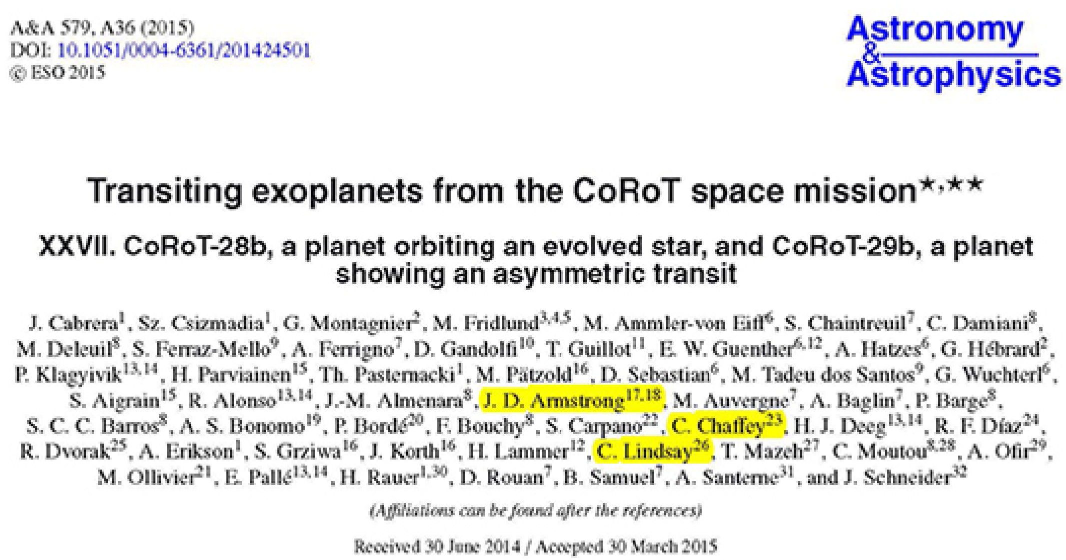
HI STAR Students Contribute to Scientific Paper


A&A 579, A36 (2015)
DOI: 10.1051/0004-6361/201424501
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Astronomy & Astrophysics

Transiting exoplanets from the CoRoT space mission*,**

XXVII. CoRoT-28b, a planet orbiting an evolved star, and CoRoT-29b, a planet showing an asymmetric transit

J. Cabrera[1], Sz. Csizmadia[1], G. Montagnier[2], M. Fridlund[3,4,5], M. Ammler-von Eiff[6], S. Chaintreuil[7], C. Damiani[8], M. Deleuil[8], S. Ferraz-Mello[9], A. Ferrigno[7], D. Gandolfi[10], T. Guillot[11], E. W. Guenther[6,12], A. Hatzes[6], G. Hébrard[2], P. Klagyivik[13,14], H. Parviainen[15], Th. Pasternacki[1], M. Pätzold[16], D. Sebastian[6], M. Tadeu dos Santos[9], G. Wuchterl[6], S. Aigrain[15], R. Alonso[13,14], J.-M. Almenara[8], J. D. Armstrong[17,18], M. Auvergne[7], A. Baglin[7], P. Barge[8], S. C. C. Barros[8], A. S. Bonomo[19], P. Bordé[20], F. Bouchy[8], S. Carpano[22], C. Chaffey[23], H. J. Deeg[13,14], R. F. Díaz[24], R. Dvorak[25], A. Erikson[1], S. Grziwa[16], J. Korth[16], H. Lammer[12], C. Lindsay[26], T. Mazeh[27], C. Moutou[8,28], A. Ofir[29], M. Ollivier[21], E. Pallé[13,14], H. Rauer[1,30], D. Rouan[7], B. Samuel[7], A. Santerne[31], and J. Schneider[32]

(Affiliations can be found after the references)

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The beginning of the article showing the authorship of Cameron Chaffey and Christopher Lindsay, as well as IfA Maui Technology Education & Outreach Specialist J. D. Armstrong, who worked with the students on this project. The project was headed by Juan Cabrera of the Institute of Planetary Research in Berlin.

One of the wonderful things about astronomy is that you don't have to be a professional scientist to make a valuable contribution. Two students who participated in the IfA-sponsored HI STAR (Hawai'i Student/Teacher Astronomy Research), a program for middle and high school students and their teachers, are among the authors of a paper about exoplanets originally discovered by the CoRoT space mission. The paper has been published in the scholarly journal *Astronomy & Astrophysics*.

Cameron Chaffey, who attends Torrance High School in California, and Christopher Lindsay, who attends 'Iolani School on O'ahu, analyzed data taken with the Faulkes Telescope North, which is part of the Las Cumbres Observatory Global Telescope Network. Their work provided the critical third observation needed to confirm that CoRoT 29b is indeed the type of exoplanet called a "hot Jupiter," a large, gaseous planet like Jupiter that orbits close to its star and is therefore hot. They were 15 and 13 years of age, respectively, when they did this work, which makes them two of the youngest scientists to ever help discover an exoplanet.

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IAU General Assembly Comes to Honolulu

The International Astronomical Union (IAU) General Assembly being held at the Honolulu Convention Center August 3-14 will be one of the largest meetings of professional astronomers ever held on planet Earth. Over 2,500 attendees from 75 countries are expected. The IAU holds a General Assembly every three years. The last meeting was held in Beijing in 2012, while Vienna will host the 2018 meeting.

Although most of the events related to the General Assembly will be for registered attendees only, there will be events for the general public as well. Stargazing parties will be held at Magic Island in Ala Moana Beach Park from sundown to 9:30 p.m. on Monday, August 3, and Thursday, August 13. Telescopes and astronomers will be present to assist the public in seeing and appreciating the night sky.

There will also be two free public talks at the Hawaii Convention Center. On Tuesday, August 4, from 7:30 to 8:30 p.m., Kālepa Babayan, astronomer in residence at the ʻImiloa Astronomy Center in Hilo and a master navigator with the Polynesian Voyaging Society, will give a public talk entitled "He Lani Ko Luna, A Sky Above: In Losing the Sight of Land, You Discover the Stars." This presentation will explain how Pacific Islanders used their indigenous system of navigation, which included a detailed knowledge of the night sky, to settle throughout the vast Pacific Ocean, and the current efforts to use these experiences to reinvigorate a once-vibrant maritime culture. From 7:30 p.m. to 9: 00 p.m., on Tuesday, August 11, 2015, IfA Director Günther Hasinger, will give a talk entitled "The Development of Modern Astronomy in Hawai'i," followed by Andrea Ghez (UCLA) talking about the black hole at the center of our Milky Way Galaxy.

In addition, Jeffrey Bennett discusses Einstein's General Theory of Relativity in a way that is accessible to nonscientists in "The Relativity Tour," which stops at the University of Hawai'i at Mānoa Art Building Auditorium at 7:30 p.m. on August 10. Bennett, who holds a PhD in astrophysics, has written numerous college textbooks, as well as science books for nonscientists, including children. His talk will be suitable for middle school age on up.

Teacher workshops will also be held in conjunction with the IAU. The Galileo Teacher Training Program's International Teacher Training Workshop, held August 8–9 at the IfA, will teach astronomy-related skills to middle and high school teachers. The Network for Astronomy School Education will also hold a teacher workshop at Bishop Museum just before the IAU starts. In addition, the Global Hands-On Universe (GHOU) Conference 2015, on August 4–5, will be an opportunity for professional astronomers and educators to meet and share "hands-on minds-on" learning in a way that bridges cultural and political divides.

Local students (middle school and above preferred) will have the opportunity to visit with leading astronomers around the world and take part in hands-on demonstrations at the IAU Exhibit Hall at the convention center on August 5 and 12. For more information and to sign up, go to http://astronomy2015.org/epo. Astronomers will also be visiting local classrooms to talk with students about astronomy.

Nā Kilo Hōkū
THE ONES WHO LOOK TO THE STARS
A Newsletter from the Institute for Astronomy, University of Hawaiʻi

Upcoming Events

Free* public events related to the International Astronomical Union General Assemby being held at the Hawaiʻi Convention Center, August 3-14.

- **Stargazing Parties** at Magic Island in Ala Moana Beach Park on **Monday, August 3** & **Thursday, August 13** at sundown to 9:30 p.m.
- Public lecture: **Kālepa Babayan** of the ʻImiloa Astronomy Center and the Polynesian Voyaging Society - He Lani Ko Luna, A Sky Above: "In losing the sight of land, you discover the stars," **Tuesday, August 4, 2015**, 7:30- 8:30 p.m., Hawaiʻi Convention Center.
  You MUST get a free ticket at https://uhifa.ticketbud.com/askyabove.
- Public lectures: **Tuesday, August 11, 2015**, Hawaiʻi Convention Center
  Dr. Günther Hasinger, Director, IfA - The Development of Modern Astronomy in Hawaiʻi, 7:30-8:15 p.m.
  Dr. Andrea Ghez, UCLA - The Black Hole in the Galactic Center, 8:15-9:00 p.m.
  You MUST get a free ticket at https://uhifa.ticketbud.com/blackhole.
- **"The Relativity Tour"** celebrating the 100th Anniversary of Einstein's General Theory of Relativity with Dr. Jeffrey Bennett, **August 10**, 7:30 p.m., University of Hawaiʻi at Mānoa Art Building Auditorium (room 132).

*Note that there are parking fees at the convention center ($10) and on the Mānoa campus ($6).

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"The Ones Who Look to the Stars"

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